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A MIDDLE DEVONIAN OCTACTINELLID SPONGE FROM NEW YORK

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The specimen of fossil sponge described in these pages was collected *in situ* from an exposure of the Middle Devonian Onondaga limestone in an abandoned quarry off New York Route 5 (Buffalo to Batavia road), near Snyder, New York. This quarry is the site of the largest fossil coral reef in western New York, and has yielded many important fossil specimens, particularly corals and bryozoans. It is also the place where fragments of the large spiny trilobite, *Terataspis grandis* (Hall), were discovered.

Fossil sponges of the octactinellid genus *Astraeospongia* are found in the Silurian and Devonian beds of Europe and North America. Most species are known only from their dissociated star-shaped spicules.

These spicules are characterized by a central disk from which radiate six rays, of equal length in most species, spaced at 60° from each other, in the "horizontal" plane. Perpendicular to this plane, two "vertical" rays spring from the central disk, one above and one below. Species known only from spicules are differentiated on (*a*) the diameter of the spicule through opposite horizontal rays; (*b*) the character of the vertical rays, which may be as long as the horizontal rays, shorter, or not developed at all; (*c*) the shape of the individual ray; and (*d*) characters of the central disk and axial canals. The spicules seem to have been placed in the living sponge in no regular orientation, except that the horizontal rays were usually parallel to the plane of the surface.

Hinde (1888) has noted the presence of the axial canal, which, however, is usually obscured by an alteration of the originally siliceous spicules to calcite. Hall and Fritz-Gaertner (1878) have reported an amazingly intricate structure of that canal, coupled with a curious interpretation of the mode of growth of the spicule. D'Arcy Thompson (1942), while satisfactorily explaining the development

of the tetractinellid and hexactinellid forms, does not discuss the octactinellid shape. Indeed, it is difficult to understand this geometrically simple form in terms of the physico-chemical processes giving rise to the others.

Five species have been described from European occurrences of this genus, one ranging from Late Ordovician to Middle Silurian, and four in the Middle Devonian. Eight species have been described from North America, one, the genotype, *Astraeospongia meniscus* (Roemer 1848), from the Middle Silurian[1] and seven from the Middle Devonian, as that division is generally understood. The distinction between some of the North American Devonian species, however, may be more apparent than real, as six of them are known only from scattered spicules. The criterion of spicule diameter, on which many descriptions depend, can be significant only in combination with other definitely distinctive features, for there is great variation in size of spicule within a single sponge. Roemer (1861, p. 14) noted a "mingling of thick and coarse-rayed stars with solitary dainty fine-rayed stars" in both *A. meniscus* and *A. patina*. Lowenstam (1948, p. 86) interprets these as respectively dermal and somatic spicules.

NOMENCLATURE OF THE GENUS ASTRAEOSPONGIA ROEMER 1854

The name of the genus has been cited as *Astraeospongia* almost exclusively since Roemer (1860, p. 14) used that spelling. In his original description of the genus (1854, pp. 155–156), he proposed the name as *Astraeospongium*, though referring in the same text to *Spongia* and *Acanthospongia*, with the Latin feminine ending. The name *Astraeospongium* (neuter) was derived from the Greek σπογγίου (neuter), meaning "a fragment of sponge." Roemer incorrectly translated this word to the Latin *spongia*, while correctly transcribing it "spongium." Other names of sponge genera from the same ultimate root stem through the Latin from the Greek σπογγιά (feminine); Roemer's emendation was probably made to be consistent with this usage.

There was no justification, under the Rules of the International Commission on Zoological Nomenclature, for Roemer's subsequent change in the spelling (see Moore, Weller, and Knight, 1942). Nevertheless, the change has been made, and has been consistently

[1] There is also "*Astraeospongia*, n. sp." of Lowenstam (1948, p. 106), from the Middle Silurian of Indiana and Illinois, regarded by him as ancestral to *A. meniscus*. Lowenstam has also reported an isolated spicule from the Early Silurian of Illinois (loc. cit.).

followed for ninety years. Therefore it appears that stability is best to be served by preservation of this originally unwarranted emendation. A communication regarding this matter has been

FIG. 33. *Astraeospongia clauda*, sp. nov. Oral surface as exposed by weathering on a bedding surface of Onondaga limestone. Spicules are dark; matrix is light. Holotype, C.N.H.M. PE999. ×½.

placed before the Secretary of the International Commission on Zoological Nomenclature.

Phylum **Porifera**

Class **Silicispongiae**

Subclass **Octactinellida**

Order, Family, etc., not named

Astraeospongia Roemer 1854, emend. Roemer 1860

Astraeospongia clauda, sp. nov.

Holotype.—C.N.H.M. PE999, a complete but crushed specimen.

Horizon and locality.—Middle Devonian, Onondaga limestone. Collected by Dr. Sharat K. Roy and Mr. Max Kopf, August, 1949, Williamsville Quarry, near Snyder, New York.

Diagnosis.—A large *Astraeospongia*, probably of cup-like shape, about 10 cm. in diameter. Spicules from 2 to 7½ mm. in diameter, with horizontal rays straight, bent, or curved, of various thicknesses, some slightly constricted proximally. Many spicules with one horizontal ray conspicuously longer than the others. Vertical rays not

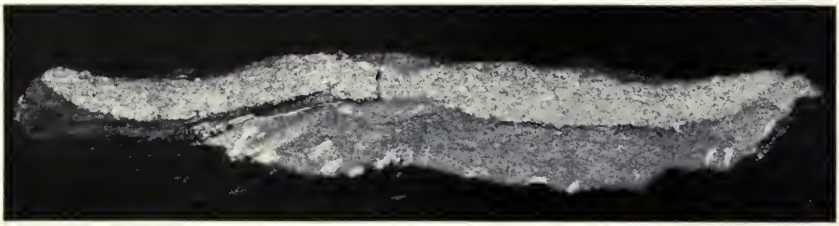

FIG. 34. *Astraeospongia clauda*, sp. nov. Cross section on a diameter, oral surface at top. The shape is the result of collapse of an originally cup-like form. Holotype, C.N.H.M. PE999. ×1.

developed. Diameter of central disk about equal to thickness of spicules; this disk may or may not be set off by a proximal constriction of the rays. Horizontal rays parallel to sponge surface. Spicular axial canals present, probably simple, cylindrical or tapering. Canal system of sponge unknown.

Discussion.—The present disk-like shape of the flattened fossil (see fig. 33) is similar to that of some Silurian specimens of *Astraeospongia meniscus* (cf. Lowenstam, 1948, pl. 3). Lowenstam (ibid., pp. 85–86, 88–104) presents an exhaustive analysis of the conditions of fossilization and preservation resulting in this shape. Though the present specimen reveals only meager evidence of its history, it probably represents a bowl-shaped sponge, flattened in the same way as the Silurian fossils. The original sponge, then, must have been shaped much like *A. meniscus*. Like some of the specimens of the latter species observed by Lowenstam, the fossil in hand has a central depression on the oral surface, simulating an osculum, probably induced by the crushing (see fig. 34).

The dermal spicules (see figs. 35 and 36) are significantly different in shape from any others described in the genus. However, it seems inappropriate to erect a new genus for their reception. The vertical rays are undeveloped, a common condition in the group. All spicules have the normal number of horizontal rays, but they are

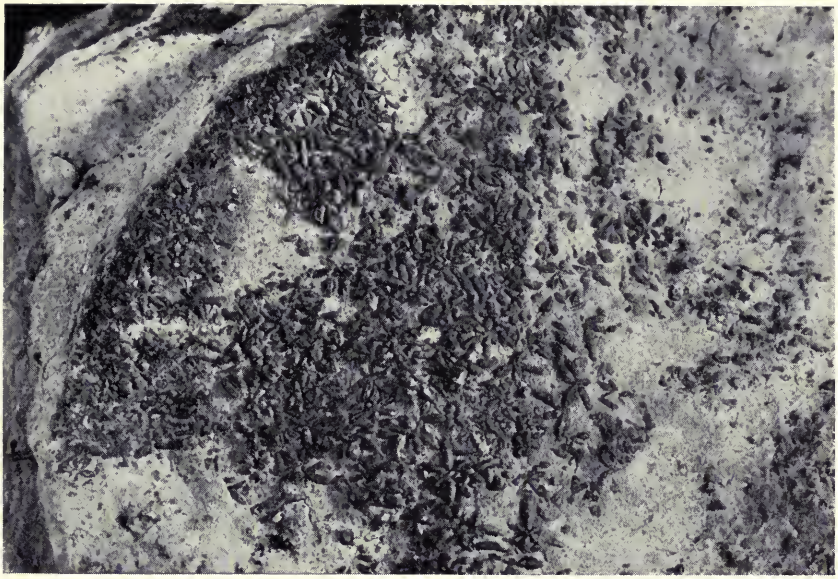

FIG. 35. *Astraeospongia clauda*, sp. nov. A group of spicules on the oral surface. Holotype, C.N.H.M. PE999. ×2.2.

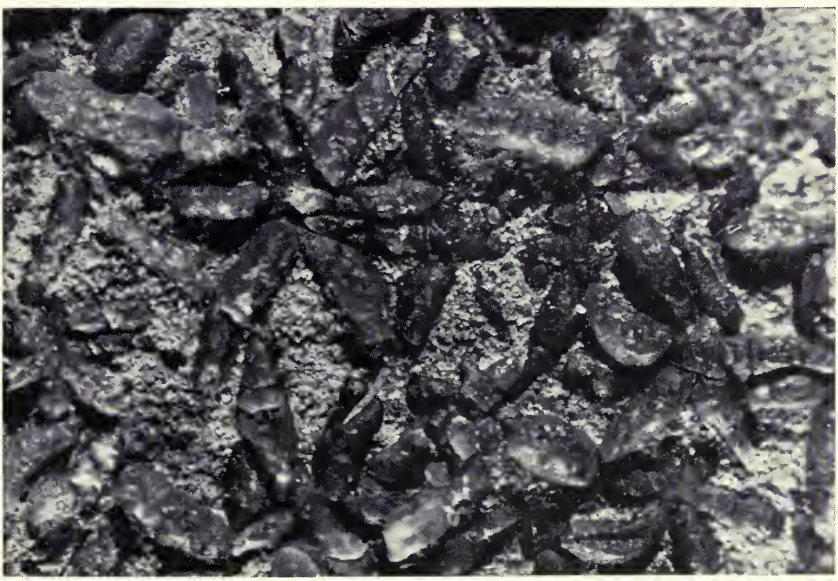

FIG. 36. *Astraeospongia clauda*, sp. nov. Spicules enlarged, showing impressing of overlapping rays and thin distal projection of rays, probably representing filling of axial canal. Holotype, C.N.H.M. PE999. ×12.3.

COMPARISON OF SPICULES IN SPECIES OF ASTRAEOSPONGIA

Species	*Age and Locality*	*Spicule Diameter*	*Spicule Characters*	*Remarks*
A. meniscus Roemer 1848	Middle Silurian, Brownsport formation, Tennessee; Louisville formation, Kentucky; Joliet to Racine formations, Illinois and Indiana.	6 to 7 mm. (Roemer, 1860, p. 14); 3 to 7 mm. (C.N.H.M. specimens).	Cylindrical with pointed ends; no vertical rays (Roemer, 1860, p. 14, and C.N.H.M. specimens).	Genotype.
A. patina Roemer 1861	Lower Silurian or Upper Ordovician (Lyckholm limestone, F_1) (Roemer, 1861, p. 15); Silurian, Wenlock shale, England; Silurian, Gotland (Hinde, 1888, p. 135).	0.36 to 1.5 mm. (Hinde, 1888, p. 135); 1 to 1.5 mm. (Roemer, 1861, p. 14).	Flattened central disk, rarely with 1 or 2 vertical rays; horizontal rays tapering very slightly, terminating obtusely (Hinde, 1888, p. 134); rays thick and blunt (Roemer, 1861, p. 14).	Known in England and Gotland only from detached spicules.
A. devoniensis Hinde 1888	Middle Devonian, Devonshire.	2½ to 5 mm. (Wells, 1943, p. 211); 2.8 to 4 mm. (measured from Hinde's figures).	Vertical rays present, as long as the horizontal rays; individual rays of variable length, of tapering conical form (Hinde, 1888, pp. 140, 141).	Known only from detached spicules. "Has no specific character" (Head, 1895, p. 6).
A. rhenanum (Schlüter 1885)	Middle Devonian, Eifel.	3 to 4 mm. (Wells, 1943, p. 211); 4 mm. (Schlüter, 1885, p. 152).	Central disk very small, vertical rays well developed, horizontal rays acicular (Wells, 1943, p. 211).	Known from detached spicules only; genotype of *Octacium* Schlüter 1885; "exceedingly doubtful form" (Head, 1895, p. 10).
A. meniscoides Dewalque 1872	Middle Devonian, Eifel and Belgium.	4 mm. (Wells, 1943, p. 211).	Vertical rays absent; horizontal rays fusiform (Wells, 1943, p. 211).	"Doubtful. See *Octacium*" (Head, 1895, p. 6).
A. hamiltonensis Meek and Worthen 1866	Middle Devonian, Hamilton group, Iowa.	3.3 mm. (Meek and Worthen, 1868, p. 419); 3.25 mm. (Wells, 1943, p. 211).	Vertical rays absent, horizontal rays one third as thick as long (Meek and Worthen, 1868, p. 419).	Originally separated from *A. meniscus* on stratigraphic grounds only.

A. ohioensis Wells 1943	Middle Devonian, Columbus limestone, Ohio.	1 to 1.5 mm.	Vertical rays as long as horizontal rays or only slightly developed; horizontal rays club-shaped or bluntly cylindrical.	Known from 5 detached spicules only.
A. onondagae Reimann 1945	Middle Devonian, Onondaga limestone, New York.	About 3 mm. average.	Central disk somewhat thickened; vertical rays short or not developed.	Known from a single patch of detached spicules.
A. canadensis Reimann 1945	Middle Devonian, Hamilton group, Ontario.	2 mm.	Vertical rays button-like.	Known from detached spicules only.
A. lancifer Reimann 1945	Middle Devonian, Hamilton group, Wanakah shale, New York.	Average 2.5 to 4, smallest 1 mm.	Rays slender, acicular, somewhat flattened above, angular below. Central disk thickened, small; vertical rays not developed.	Known only from patches of detached spicules.
A. acicularis Reimann 1945	Middle Devonian, Hamilton group, Wanakah shale, New York.	Average about 2.5 to 4 mm.	Rays slender, acicular, very flat above. Central disk small, scarcely thickened.	Known only from isolated spicules and patches of spicules.
A. rusticus Reimann 1945	Middle Devonian, Hamilton group, Wanakah shale, New York.	1 to 2 mm.	Horizontal rays strong and rounded, partly lapping onto thin central disk.	Known only from 2 spicules.
A. eifelensis Schlüter 1885				"Doubtful. See *Octacium*" (Head, 1895, p. 6). Head's listing of this species appears to be its only appearance in print; it is not mentioned by Schlüter in 1885.

neither equally spaced, of equal length, of equal diameter, nor straight. A random selection of spicules is shown in figure 37, from camera lucida sketches. The rays curve or bend unsystematically. Though many spicules have undoubtedly been disarranged in the

FIG. 37. Spicules of *Astraeospongia clauda*, sp. nov. Rays terminating in a jagged line pass beneath the matrix or another spicule. The black line represents one millimeter, to the same scale of magnification as the spicules. Camera lucida drawings from holotype, C.N.H.M. PE999. ×5.

sagging of the sponge, several groups on the oral surface have apparently remained in their original mutual relations. In these groups, some of the bent rays interlock, indicating that their bending is probably the result of mutual interference and adjustment during growth. Where a ray meets a neighboring spicule, it either stops or continues across the other. In the fossil state, the crossing rays are deeply imbedded into those crossed. As this seems an impossible situation if the mineral spicule is formed either on the surface of a cell, as D'Arcy Thompson shows for certain forms, or within a polynucleate syncytium, as shown by, for example, Hyman (1940, pp. 300, 301), the imbedding of these rays may have occurred during the alteration of the siliceous spicule to calcite. Both bent and mutually impressed rays can be seen rarely in calcified spicules of undeformed specimens of *A. meniscus* from Decatur County, Tennessee (specimens in Chicago Museum collection).

The rays of certain spicules narrow abruptly, the distal portion having a much smaller diameter than the proximal. It seems likely that this thin extension represents a filling of the axial canal; its diameter is about one-fifth the diameter of the ray.

The spicules, probably originally of silica, are now composed of crystalline calcite. The interior of the sponge body, exposed by a saw cut on a diameter (see fig. 34), is composed of crystalline calcite, probably representing a mass of altered spicules. Shapes of spicules within the body are not determinable; if there are somatic spicules with vertical rays, they are not to be seen.

Comparisons.—The irregularity of form of the spicules sets this species off from all other species of *Astraeospongia*, yet occasional deformed spicules in specimens of the genotype itself show that the relationship is not distant. In diameter, the spicules are most closely comparable to the more slender and regular spicules of *A. meniscus*. The table compares the characters of the spicules of the several species.

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